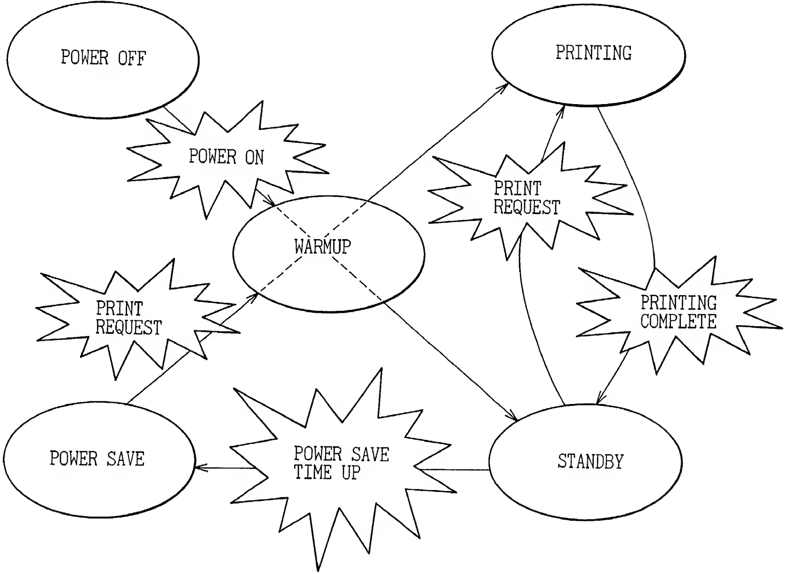
Fig.1

PRIOR ART



US

Fig.2

PRIOR ART

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version|  IHL  |Type of Service|          Total Length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Identification        |Flags|      Fragment Offset    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Time to Live |    Protocol   |         Header Checksum       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination Address                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Options                    |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Example Internet Datagram Header (From RFC791)

Fig. 3

PRIOR ART

```
 '0                   1                   2                   3
  0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |       Ethernet destination address (first 32 bits)            |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | Ethernet dest (last 1 6bits   |Ethernet source (first 16 bits)|
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |       Ethernet source address (last 32 bits)                   |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |        Type code              |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Fig.4

PRIOR ART

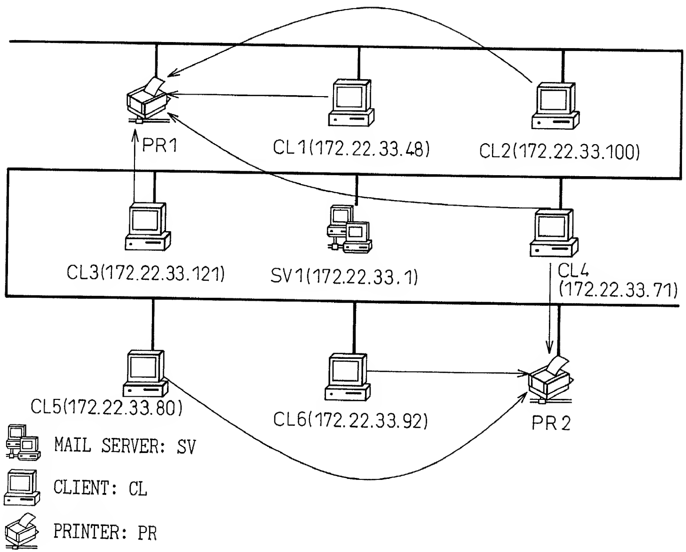


Fig.5

PRIOR ART

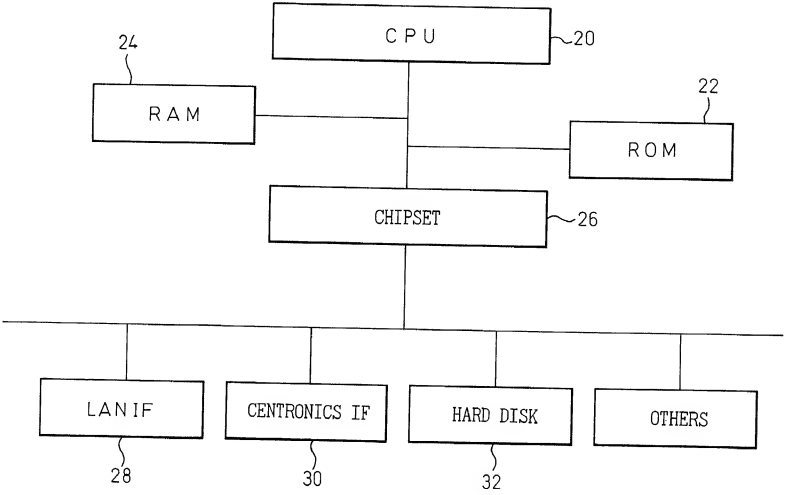


Fig.6

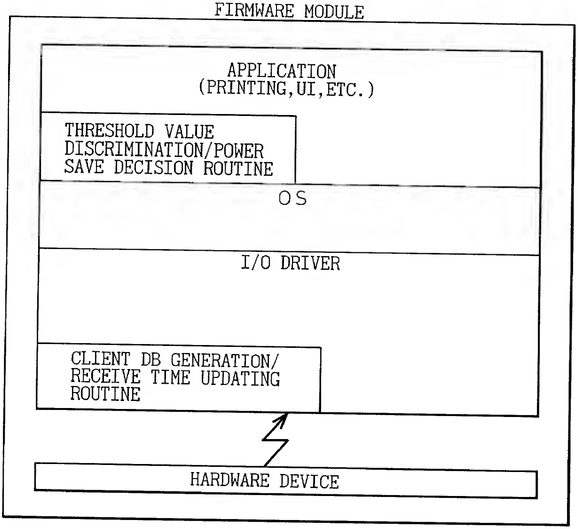

FIRMWARE MODULE
APPLICATION
(PRINTING,UI,ETC.)
THRESHOLD VALUE
DISCRIMINATION/POWER
SAVE DECISION ROUTINE
OS
I/O DRIVER
CLIENT DB GENERATION/
RECEIVE TIME UPDATING
ROUTINE
HARDWARE DEVICE

Fig.7

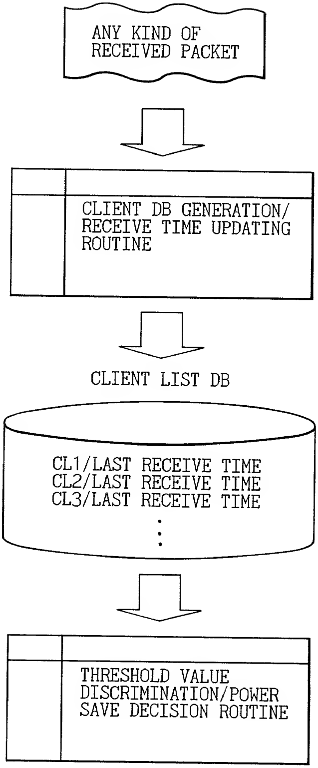

ANY KIND OF RECEIVED PACKET
CLIENT DB GENERATION/ RECEIVE TIME UPDATING ROUTINE
CLIENT LIST DB
CL1/LAST RECEIVE TIME
CL2/LAST RECEIVE TIME
CL3/LAST RECEIVE TIME
⋮
THRESHOLD VALUE DISCRIMINATION/POWER SAVE DECISION ROUTINE

Fig.8

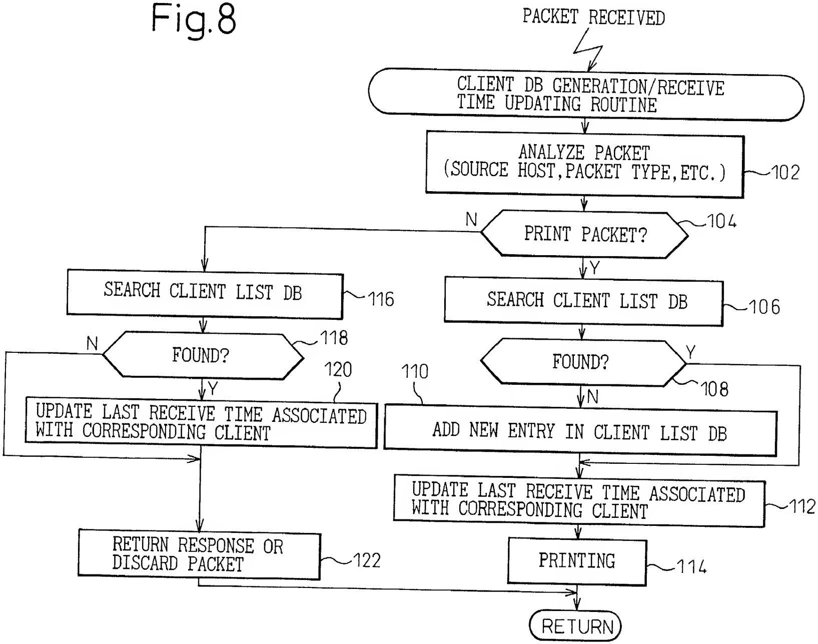

PACKET RECEIVED
CLIENT DB GENERATION/RECEIVE TIME UPDATING ROUTINE
ANALYZE PACKET (SOURCE HOST, PACKET TYPE, ETC.)
102
PRINT PACKET?
104
N
Y
SEARCH CLIENT LIST DB
106
FOUND?
108
Y
N
ADD NEW ENTRY IN CLIENT LIST DB
110
UPDATE LAST RECEIVE TIME ASSOCIATED WITH CORRESPONDING CLIENT
112
PRINTING
114
SEARCH CLIENT LIST DB
116
FOUND?
118
N
Y
UPDATE LAST RECEIVE TIME ASSOCIATED WITH CORRESPONDING CLIENT
120
RETURN RESPONSE OR DISCARD PACKET
122
RETURN

Fig.9

```
Packet 1:  00:80:17:88:2C:B6 -> broadcast
     Network:  Ethernet
     Frame type:  802.3,  Frame size:  60
     Time:  18h:17m 17.505sec
ARP     REQUEST
     Hardware Type: [1] ETHERNET,    Protocol type: [0800]   IP
     Source host:          172.22.33.48                                    <- CL1
     Destination host:  172.22.33.55
     Source Hardware address:         00:80:17:88:2C:B6
     Destination Hardware address:  broadcast
    ------------------------------------------------------------
    ------------------------------------------------------------

Packet 2:  00:90:27:08:20:B2 -> broadcast
     Network:  Ethernet
     Frame type:  802.3,  Frame size:  60
     Time:  18h:21m 19.999sec
ARP     REQUEST
     Hardware Type: [1] ETHERNET,    Protocol type: [0800]   IP
     Source host:          172.22.33.100                                   <- CL2
     Destination host:  172.22.33.104
     Source Hardware address:         00:90:27:08:20:B2
     Destination Hardware address:  00:00:00:00:00:00
    ------------------------------------------------------------
    ------------------------------------------------------------

Packet 3:  00:A0:C9:6F:5E:2B -> broadcast
     Network:  Ethernet
     Frame type:  802.3,  Frame size:  60
     Time:  18h:23m 24.797sec
ARP     REQUEST
     Hardware Type: [1] ETHERNET,    Protocol type: [0800]   IP
     Source host:          172.22.33.121                                   <- CL3
     Destination host:  172.22.33.24
     Source Hardware address:         00:A0:C9:6F:5E:2B
     Destination Hardware address:  00:00:00:00:00:00
    ------------------------------------------------------------
    ------------------------------------------------------------

Packet 4:  00:00:0E:6E:04:50 -> broadcast
     Network:  Ethernet
     Frame type:  802.3,  Frame size:  60
     Time:  18h:29m 25.327sec
ARP     REQUEST
     Hardware Type: [1] ETHERNET,    Protocol type: [0800]   IP
     Source host:          172.22.33.1                                     <- SV1
     Destination host:  172.22.33.41
     Source Hardware address:         00:00:0E:6E:04:50
     Destination Hardware address:  00:00:00:00:00:00
```

Fig.10

```
Packet 5:   00:A0:C9:6F:5E:2B -> broadcast
     Network:   Ethernet
     Frame type:   802.3,   Frame size:   60
     Time:   18h:29m 28.960sec
ARP      REQUEST
     Hardware Type: [1] ETHERNET,     Protocol type: [0800]   IP
     Source host:           172.22.33.121                                  <- CL3
     Destination host:   172.22.33.27
     Source Hardware address:           00:A0:C9:6F:5E:2B
     Destination Hardware address:   00:00:00:00:00:00
    -----------------------------------------------------------
    -----------------------------------------------------------

Packet 6:   00:00:0E:6E:04:50 -> broadcast
     Network:   Ethernet
     Frame type:   802.3,   Frame size:   60
     Time:   18h:33m 30.292sec
ARP      REQUEST
     Hardware Type: [1] ETHERNET,     Protocol type: [0800]   IP
     Source host:           172.22.33.1                                    <- SV1
     Destination host:   172.22.33.41
     Source Hardware address:           00:00:0E:6E:04:50
     Destination Hardware address:   00:00:00:00:00:00
    -----------------------------------------------------------
    -----------------------------------------------------------

Packet 7:   00:80:17:88:2C:B6 -> broadcast
     Network:   Ethernet
     Frame type:   802.3,   Frame size:   60
     Time:   18h:34m 40.689sec
ARP      REQUEST
     Hardware Type: [1] ETHERNET,     Protocol type: [0800]   IP
     Source host:           172.22.33.48                                   <- CL1
     Destination host:   172.22.33.55
     Source Hardware address:           00:80:17:88:2C:B6
     Destination Hardware address:   broadcast
    -----------------------------------------------------------
    -----------------------------------------------------------

Packet 8:   00:80:17:88:2C:B6 -> broadcast
     Network:   Ethernet
     Frame type:   802.3,   Frame size:   60
     Time:   18h:36m 43.510sec
ARP      REQUEST
     Hardware Type: [1] ETHERNET,     Protocol type: [0800]   IP
     Source host:           172.22.33.48                                   <- CL1
     Destination host:   172.22.33.55
     Source Hardware address:           00:80:17:88:2C:B6
     Destination Hardware address:   broadcast
```

Fig.11

CLIENT (ADDRESS)	LAST RECEIVE TIME
CL1 (172.22.33.48)	18h: 36m 43.510sec
CL2 (172.22.33.100)	18h: 21m 19.999sec
CL3 (172.22.33.121)	18h: 29m 28.960sec
CL4 (172.22.33.71)	17h: 29m 28.324sec

Fig.12

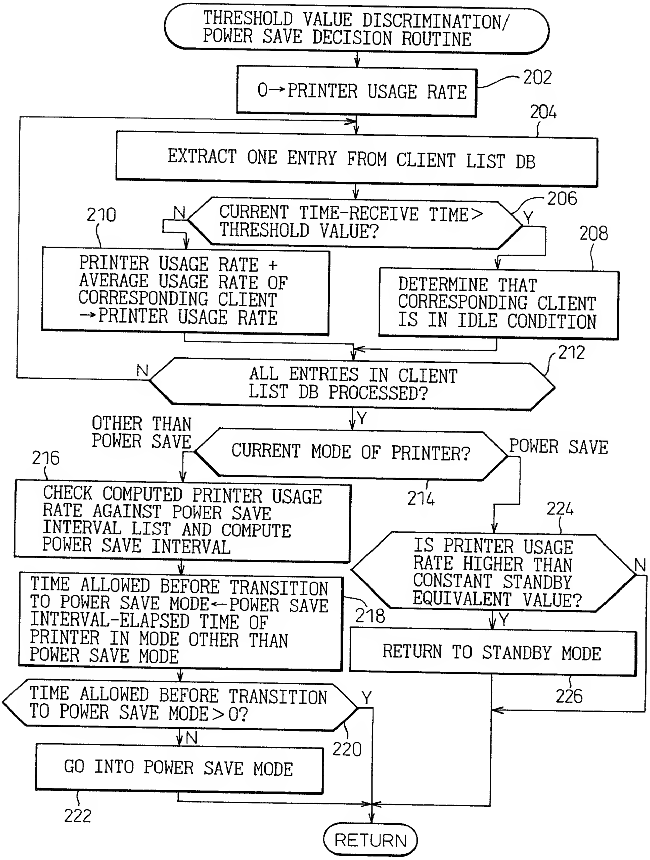

THRESHOLD VALUE DISCRIMINATION/ POWER SAVE DECISION ROUTINE
0→PRINTER USAGE RATE
202
204
EXTRACT ONE ENTRY FROM CLIENT LIST DB
206
CURRENT TIME-RECEIVE TIME> THRESHOLD VALUE?
N
Y
210
PRINTER USAGE RATE + AVERAGE USAGE RATE OF CORRESPONDING CLIENT →PRINTER USAGE RATE
208
DETERMINE THAT CORRESPONDING CLIENT IS IN IDLE CONDITION
212
ALL ENTRIES IN CLIENT LIST DB PROCESSED?
N
Y
OTHER THAN POWER SAVE
CURRENT MODE OF PRINTER?
POWER SAVE
214
216
CHECK COMPUTED PRINTER USAGE RATE AGAINST POWER SAVE INTERVAL LIST AND COMPUTE POWER SAVE INTERVAL
224
IS PRINTER USAGE RATE HIGHER THAN CONSTANT STANDBY EQUIVALENT VALUE?
N
Y
TIME ALLOWED BEFORE TRANSITION TO POWER SAVE MODE←POWER SAVE INTERVAL-ELAPSED TIME OF PRINTER IN MODE OTHER THAN POWER SAVE MODE
218
RETURN TO STANDBY MODE
226
TIME ALLOWED BEFORE TRANSITION TO POWER SAVE MODE>0?
Y
N
220
GO INTO POWER SAVE MODE
222
RETURN

Fig.13

CLIENT	CONDITION (○…WORKING ×…IDLE)
CL1	○
CL2	○
CL3	○
CL4	×
CL5	×
CL6	×
SV1	○

Fig.14

CLIENT	AVERAGE USAGE RATE	
	PR1	PR2
CL1	10	0
CL2	35	0
CL3	40	0
CL4	10	20
CL5	0	25
CL6	0	20
SV1	0	0

UNIT (PAGES/HOUR)

Fig.15

PRINTER USAGE RATE X	POWER SAVE INTERVAL
X>90	CONSTANT STANDBY
90>=X>50	120min
50>=X>10	60min
10>=X	30min
X=0	0min (IMMEDIATELY GOES INTO POWER SAVE MODE)